APPENDIX D
LONWORKS TECHNOLOGY OVERVIEW

D-1 WHAT IS LONWORKS?

LONWORKS is a commonly-used term used to describe the products and technology built around the ANSI-709.1 communications protocol. This protocol was originally developed by the Echelon Corporation and implemented on a Neuron chip. Since then, the protocol has become an ANSI standard and has been implemented in other chips and in software.

The main components to 'LONWORKS technology' are the protocol, LONWORKS network services, the LonMark SNVT list, and additional information published by LonMark.

D-2 ANSI-709.1 COMMUNICATION PROTOCOL

LONWORKs technology is based on ANSI standard protocol, ANSI/EIA 709-A-1999. The protocol can be openly implemented by a microprocessor of choice by using the downloadable reference implementation of the protocol. In practice though, due to it's low cost, most control manufacturers use the Neuron® chip which is patented by a private corporation. The protocol can be (and has been) implemented on third-party microprocessors.

At the building level, LONWORKs consists of a standard flat ANSI 709.1 network with logical segmentation accomplished using routers to segment the network and to manage communications and bandwidth. In large buildings a high speed TP/XF-1250 backbone can be used with TP/FT-10 segmenting. This arrangement remains logically flat. In UMCS applications Internet Protocol (IP) is used as a high-speed backbone. An ANSI/EIA 709.1 and ANSI/CEA-852 compliant 709.1-to-IP router is used to interface the building-level network to the high-speed base-wide Utility Monitoring and Control System (UMCS) network.

D-3 LONWORKS NETWORK SERVICES

Requirements for an open system include more than a standard communication protocol. One other key requirement is the ability to configure and manage the network. A software tool is used to manage network services. While network services are not necessary for day-to-day intercommunication of devices, they are the focal point for system expansions or modifications. An open network service, such as LonWorks® Network Service (LNS™), allows third-party contractors to access, expand, and manipulate all devices on the network. Closed network services are available but should be avoided.

LonWorks Network Services (LNS) is a network management and database standard for ANSI 709.1 control networks. It is sometimes referred to as a 'network operating system', although this terminology can be misleading. Essentially, LNS provides an interface between software packages and the network, and maintains a database of the network containing device configuration (settings) information as well as current point value information. Software that uses LNS is called *LNS-compatible* or *LNS-compliant*.

LNS is not purchased as a piece of software, but is obtained as part of another LNS-compatible software package. Generally, an LNS Network Configuration Tool (ie an LNS-compliant network configuration tool) will be used to initially create the network, thereby creating the LNS Database and providing the services LNS needs to interface with the network. Other front-end software, such as the Monitoring and Control software uses the LNS Database to obtain or send information to the network.

The computer on which LNS is installed is called the LNS Server. This is the computer that other software 'looks to' in order to access the database, and is the computer that interfaces with the network to read/write information on the network.

A single LNS Server (a single 'copy' of LNS) can interface to many LNS Databases, including those that reside on other computers. In this case, the LNS Server is the single point of contact for software interfacing to LNS, and LNS will interface with the different databases as needed. LNS will automatically open and close databases as required, and can interface to several databases at once.

Each LNS Database holds the information for one *domain* (see addressing discussion for more information on domains) of up to 32,385 nodes.

D-4 STANDARD NETWORK VARIABLE TYPES (SNVTS)

Devices communicate over the network using the ANSI 709.1 communication protocol. This protocol, in part, defines how to send information between devices in the form of *network variables*. It does not, however, define the format for the content of the network variable. A useful analogy is to thing of the network variable as a letter. The protocol defines how the letter should be packaged and addresses, and makes sure it is delivered to the correct place but does not define the content or format of the letter itself.

LonMark International (formerly the LonMark Interoperability Organization) has defined standard formats for network variables, called Standard Network Variable Types (SNVTs). This facilitates interoperability of different manufacturer's devices, since there is a standard format for the data. In support of the flat and open architecture, all system-wide communications are required to be 'implicit' ANSI/EIA 709.1 SNVTs. These types are indicated/written as SNVT_name, where 'name' is the name (or abbreviation of the name) of the SNVT. For example, SMVT_temp is Standard Network Variable Type Temperature and SNVT_occupancy is Standard Network Variable Type Occupancy.

The down side of this Master List, however, is that it covers a full range of applications so there are several different Types for the same type of information. For example, the SNVT Master List defines 3 SNVTs for temperature in addition to one for differential temperature and one for temperature rate of change. Although the Master List indicates that SNVT_temp_p should be used for HVAC applications, there is no guarantee that all controllers used in HVAC-related applications will use this type rather than SNVT_temp or SNVT_temp_f (the other temperature options).

The Points Schedule lists SNVT types in an attempt to ensure that the devices can communicate as expected/needed. It's important to note, however, there there are 'type translators' available as part of many ANSI-709.1 devices which can translate between SNVT Types.

It's also important to note that the term SNVT is used in two ways. Technically it is the acronym for Standard Network Variable Type, and is sometimes used in this manner. However, it is often used to indicate the network variable itself (ie it can mean "a network variable of a standard network variable type"). In general, the intended meaning should be clear from the context.

A network variable which is not in the format of a SNVT is of a user-defined network variable type (UNVT). These types are defines by device manufacturers.

D-5 LONMARK INTERNATIONAL

LONWORKS devices are available for a wide variety of applications, down to the sensor level, supporting a wide variety of applications extending beyond HVAC control. LonMark International provides device certification. Certified devices must adhere to a 'Functional Profile' which basically defines its network input/output communications data and capabilities. An up-to-date listing of certified devices can be found on the LonMark Website (http://www.lonmark.org/products/lmprod.htm). Some device categories contain only one or two certified devices (although suitable uncertified devices may be available for some of these categories). The UFC and UFGS provides guidance on overcoming this limitation and industry momentum shows that new devices are being certified on a regular basis. Some common HVAC control systems, such as a return fan VAV system, are not covered by a device category. These systems will require the use of a non-certified device. Use of a non-certified device can complicate the process of ensuring that the device is open and LONWORKS compatible therefore requirements are defined in the 'HVAC and Other Local Building Control Systems' UFC and UFGS guidance.

D-5.1 Functional Profiles

LonMark has developed 'Functional Profiles' for ANSI-709.1 devices. These profiles describe network inputs, outputs and configuration parameters that different types of controllers must have. LonMark certifies ASCs to these functional profiles. Unfortunately, functional profiles have a few weaknesses/limitations:

- They tend to have a significant portion of the network input/output 'requirements' as optional inputs/outputs. Often the inputs/outputs we need aren't mandatory so it's not sufficient to just say 'use the functional profile"
- There are not functional profiles for every application
- It doesn't specify all the hardware Inputs/Outputs (it may specify some of them indirectly).
- It doesn't specify the sequence of operation that the controller performs (doesn't say what to do with the inputs and how to determine the outputs)

There are several benefits to using a functional profile. Probably the most significant is that it provides a reasonable expectation that the device will perform 'properly' on the

network. That is that it will communicate with other ANSI 709.1 devices and is a 'good neighbor' on the network (doesn't use immense bandwidth, for instance)

D-5.2 **Configuration Parameters**

To be useful, a controller must be configurable for the specific application in which it will be used. In LonWorks devices, this configuration is generally accomplished through *configuration parameters (CPs)* (sometimes called *configuration properties*). These Configuration Parameters are stored in the device (and in the LNS Database) and are accessed using an LNS Network Management Tool.

There are 2 types of CPs, standard- and user-defined configuration parameter types (SCPTs and UCPTs). LonMark maintains a master list of SCPTs, and the SCPT format is often described by relating it to a SNVT type. UCPTs are defined by the device manufacturers. Since configuration parameters are not used for device to device communications and the CP information is stored in the LNS database (and documented in the drawings), either CP type is acceptable.

In some cases a device will also have hardware configuration settings. These are generally dip-switches or dials on the controller itself. For example, a single device may be capable of accepting either a 0-10VDC or 4-20mA signal, and the signal type may be selected on the device through a set of switches.